Chapter 5: Assessment of Baseline and Estimate of Natural Conditions in Class I Areas

5.1 Visibility Requirements

One of the core requirements of the implementation plan for regional haze is the calculations of baseline and natural visibility conditions. For each mandatory Class I area, the state must determine the conditions in terms of a haze index (HI) expressed in units of deciviews.

When calculating the baseline visibility conditions, the period for establishing the conditions is 2000 to 2004. Available monitoring data must be used in the calculations to establish the average degree of visibility impairment for the most and least impaired days for each calendar year from 2000 to 2004. The baseline visibility conditions are the average of these annual values. When there is no onsite monitor data available, the state must establish baseline values using the most representative data available.

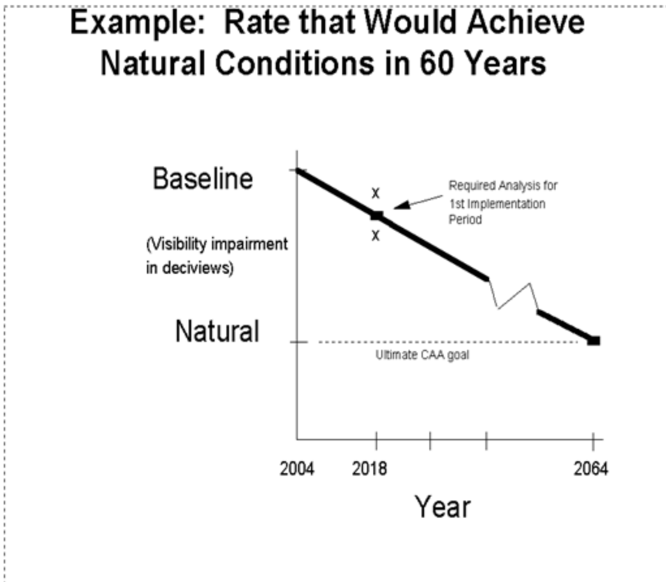
Because there was little onsite monitoring data for the designated years at Breton WA, substitute data was used from the SEARCH monitor located in Gulfport, MS. This is more fully discussed in section 5.3 of this chapter.

The objective of the RH rule is to restore each Class I area to its natural visibility conditions. In order to determine the "reasonable progress" toward this objective, there are three metrics of visibility that are part of this determination: 1.) baseline conditions, 2.) natural conditions, and 3.) current conditions. Each of the three metrics is determined using a light extinction algorithm that includes each visibility species expressed in different terms of its concentration, light extinction coefficient, and relative humidity factor. The Haze Index (dv) is calculated for the total light extinction (b_{ext}) for the average of the 20 percent best and 20 percent worst visibility days. (See section 5.2)

Baseline visibility is the starting point for the improvement of visibility conditions. It is the average of the IMPROVE monitoring data for 2000 through 2004. The comparison of baseline conditions to natural visibility conditions indicates the amount of improvement necessary to attain natural visibility by 2064.

Natural visibility is determined by estimating the natural concentrations of visibility species and then calculating total light extinction efficiency with the light extinction algorithm. To illustrate, see Figure 5.1 for both baseline and natural visibility conceptions. Each state must estimate natural visibility levels for Class I areas within its borders in consultation with FLMs and other states (51.308(d)(2)).

Figure 5.1 Determination of Natural Background



5.2 Default and Refined Values for Natural Visibility Conditions

EPA's Guidance for Estimating Natural Visibility Conditions under the Regional Haze Program (Sept 2003) provides that states may use a "refined approach" to estimate the values that characterize visibility conditions of the Class I areas. The purpose of such a refined approach would be to provide more accurate estimates with changes to the light extinction algorithm. This refined algorithm accounts for additional factors such as particle size distributions, geographical variation (by altitude) of a fixed value, and the addition of visibility species. States can choose between the default and refined equations.

Either equation(default or refined) is used to calculate baseline and current conditions of visibility due to haze-causing pollutants and the same equation is used to calculate natural visibility now using the estimates of natural concentrations of the same pollutants.

The old (default) algorithm:

$$
\begin{aligned}
b_{ext} \approx\ & 3 \times f(RH) \times [Sulfate] \\
& + 3 \times f(RH) \times [Nitrate] \\
& + 4 \times [Organic\ Carbon] \\
& + 10 \times [Elemental\ Carbon] \\
& + 1 \times [Fine\ Soil] \\
& + 0.6 \times [Coarse\ Mass] \\
& + 10
\end{aligned}
$$

where the concentration for each species in μg/m^3 is converted to its light extinction b_{ext} in inverse megameters (Mm^{-1}). Associated with each species is a light extinction coefficient constant and for the sulfate and nitrate a hygroscopic factor *f*(Rh).

The new (refined) algorithm: (Differences from the default are in bold)

$$
\begin{aligned}
b_{ext} \approx\ & 2.2 \times f_S(RH) \times [Small\ Sulfate] + 4.8 \times f_L(RH) \times [Large\ Sulfate] \\
& + 2.4 \times f_S(RH) \times [Small\ Nitrate] + 5.1 \times f_L(RH) \times [Large\ Nitrate] \\
& + 2.8 \times [Small\ Organic\ Carbon] + 6.1 \times [Large\ Organic\ Carbon] \\
& + 10 \times [Elemental\ Carbon] \\
& + 1 \times [Fine\ Soil] \\
& + 1.7 \times f_{SS}(RH) \times [Sea\ Salt] \\
& + 0.6 \times [Coarse\ Mass] \\
& + Rayleigh\ Scattering\ (Site\ Specific) \\
& + 0.33 \times [NO_2\ (ppb)]
\end{aligned}
$$

where new terms have been added for small and large size distributions, sea salt, nitrites, and site specific Rayleigh light scattering.

The total sum of the species light extinctions, (b_{ext}) in units of inverse Megameters (Mm^{-1}) is used to calculate visibility expressed as the haze index (HI) in units of deciviews (dv):

$$HI=10 \ln(b_{ext}/10)$$

The choice between use of the default or the refined equation for calculating the visibility metrics for each Class I area is made by the state in which the Class I area is located. It is with these calculations that the state has developed a "reasonable progress goal" for each Class I area, in consultation with other states whose emissions affect visibility in that park or wilderness area (sec. 51.308(d)(1)(iv)). LDEQ has used the refined equation to calculate visibility metrics for the purpose of developing its reasonable progress goal.

In EPA's "*Guidance on the Use of Models and other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze*", April, 2007, a footnote on page 79 reads in part, "…the same algorithm [old or new] should be used to calculate the glidepath…" LDEQ interprets this to mean that if the baseline conditions are calculated using the new IMPROVE algorithm, then the natural visibility conditions should also be calculated using the new IMPROVE algorithm. Using the newly refined equation, LDEQ has determined that natural visibility conditions for the Breton Class I area for the average 20% worst days is best represented by 11.93 dv (see Appendix D of the Technical Support Document or Appendix B).

5.3 Baseline Visibility Conditions at Breton WA

A baseline of 13.12 dv for the 20% best days and 25.73 dv for the 20% worst days has been established for the Breton WA using a sample of the monitored data representing the five year period beginning in 2000 (See Table 5.1). Because the data from the Breton IMPROVE monitor does not meet EPA completeness criteria for the five year averaging period (i.e. less than 75% valid data collection in a calendar year), data from two relatively close monitoring sites, the Gulfport Search site and the Sikes IMPROVE site, were considered to provide missing data.

A statistical analysis of the two proposed data sets was provided to the VISTAS RPO by Joe Adlhoch of Air Resource Specialists. The analysis demonstrated that the seasonal correlations of species mass comparisons were statistically more significant between Breton and Gulfport than Breton and Sikes. For this reason, Gulfport was selected as the only source for substitute data for the baseline period. Results of the analysis performed by VISTAS are included in Appendix C.

The Breton WA monitor started late in the year 2000, therefore 2000 data can not be used, thus a four year average (2001 to 2004) was calculated for each value (both best and worst) instead of the five year (2000 to 2004) average in accordance with 40 CFR 51.308(d)(2). The light **total** extinction efficiency and haze index visibility values for the worst and best days are based on data and calculations as well as the summary data with the concentration values, light extinction calculations, and deciview values can be found in the Technical Support Document (Appendix B)

LDEQ acknowledges the problem of having weak monitoring data. With the submission of the 5-yr report, LDEQ will review the calculation of current conditions, reconstruct the uniform rate of progress, and proactively make all assessments required under 40 CFR 51.308(g) and (h), including a diligent re-assessment of the reasonable progress goals as required by 51.308(h)(3) and (4).

5.4 Natural Visibility Conditions

The Breton Class I area has an estimated natural background visibility of 4.25 deciviews on the 20 percent best days and 11.93 dv on the worst 20 percent of days (See Table 5.1). The Technical Support Document provides calculations and methodologies, and includes a demonstration of the appropriateness of these values for Breton as well as a discussion of the reasons for the selection of the methodology.

Table 5.1 Visibility Metrics for the Class 1 Areas in Louisiana

Natural Background Conditions				
Class 1 area Breton	Average for 20% Worst Days (dv) 11.93	Average for 20% Best Days (dv) 4.25	Average for 20% Worst Days Bext (Mm-1) 32.97	Average for 20% Best Days Bext (Mm-1) 15.30
Baseline Visibility Conditions 2000-2004				
Class 1 area	Average for 20% Worst Days (deciviews) 25.73	Average for 20% Best Days (deciviews) 13.12	Bext (Mm-1) Average for 20% Worst Days 131.05	Bext (Mm-1) Average for 20% Best Days 37.14